

PATENT ABSTRACTS OF JAPAN

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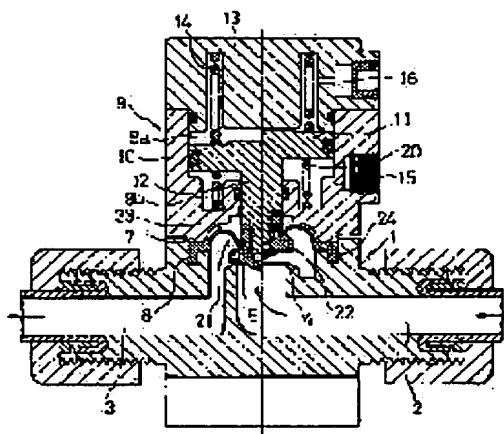
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(54) DIAPHRAGM VALVE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce a shock of a valve element on a valve seat without impairing response so as to press a valve element softly against a valve seat in order to suppress particles from producing by reducing the acceleration of a piston by a spring using a damper spring when the valve is closed so as to damp a pressing force.

SOLUTION: A diaphragm 21 of a diaphragm valve is made of PTFE, and forms an annular thin film part 23 formed in an upward spherical shape integrally with it around a valve element 22 located at the center of it and also forms a cylindrical holding part 24 integrally with it around the annular thin film part 23. Also the diaphragm valve is of the normally closed type, and its piston 11 is excited downward by a spring 14 installed into the upper chamber 9a of a cylinder 9 so as to brought a valve element 22 connected to a lower side rod 12 in contact with a valve seat 5. In addition, a damper spring 20 is provided in the lower chamber 9b of the cylinder 9. Thus, when the valve is closed, the valve element 22 can be pressed softly against the valve seat 5 so as to suppress particles from producing.



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CLAIMS

[Claim(s)]

[Claim 1] In the diaphragm valve made of the resin of the normal close type which presses with the piston energized with the spring in which the diaphragm made from PTFE was inserted by the valve seat side of a valve box at the cylinder top room, and intercepts flowing fluid for the interior of a valve box A damper spring is inserted in the bottom room of said cylinder. Said diaphragm A central valve element, It consists of the annular thin film section formed in the perimeter of the valve element at one, and a tubed attaching part formed in the perimeter of the annular thin film section at one. The diaphragm valve characterized by curving said annular thin film section in the shape of a cross-section facing-up ball, and connecting the root section of inner circumference almost at right angles to the top face of said valve element, and connecting the root section of a periphery almost at right angles to the inner skin upper limb of said tubed attaching part.

[Claim 2] The diaphragm valve according to claim 1 which sets to A the diameter of the root section of the periphery of the annular thin film section curved in the shape of [of diaphragm] a cross-section facing-up ball, sets the diameter of the root section of inner circumference to C, sets the diameter of a valve element to B, and is characterized by setting up so that the ratio of A and B may become small as much as possible, while making as [become / $A > B > C$].

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the diaphragm valve made of resin used at wet stations, such as a washing station of a silicon wafer, and an etching system, in semiconductor fabrication machines and equipment.

[0002]

[Description of the Prior Art] If drawing 3 explains an example of the diaphragm valve made of the resin of the conventional above-mentioned application, 1 is a valve box and the fluid outflow path 3 is established in the 1 side at the side the fluid inflow path 2 and else. Opening is carried out at right angles to the core in a valve box 1, the opening periphery is extended, projection 4 is formed, and the outlet side of the fluid inflow path 2 serves as the valve seat 5 of the shape of cross-section radii with the small tip of the projection 4. 6 is the diaphragm made from PTFE, as shown in drawing 4, it has in the center valve element 6a stuck to a valve seat 5 by pressure, has annular thin film section 6b formed in the perimeter of a lower limit of the valve element 6a at one, and has tubed attaching part 6c formed in the perimeter of the annular thin film section 6b at one. In drawing 3, 7 is the diaphragm presser foot which presses down tubed attaching part 6c of the diaphragm 6 attached in the slot 8 of the perimeter in a valve box 1, this diaphragm presser foot 7 is formed in the lower limit side of the case 10 of the cylinder 9 of a valve mechanical component at one, and press immobilization is carried out into the tubed attaching part 6c fang furrow 8 by having bound the case 10 tight on the opening top face of a valve box 1, and having fixed. Valve element 6a of the center of diaphragm 6 is combined with the bottom rod 12 of a piston 11. A spring 14 is inserted in top room 9 between piston [of a cylinder 9] 11, and cap 13 a, and the piston 11 is energized caudad. 15 is the Ayr inlet to bottom room of cylinder 9 9b, and 16 is the Ayr free passage opening of cylinder 9 top room 9a and the exterior.

[0003] Thus, if Ayr is introduced to bottom room of cylinder 9 9b, the constituted diaphragm valve If resist a spring 14 and a piston 11 goes up, valve element 6a of the center of the diaphragm 6 combined with the bottom rod 12 is isolated, and is opened from a valve seat 5 and Ayr is extracted from bottom room of cylinder 9 9b It is the normal close type with which clausilium of the valve element 6a of the center of the diaphragm 6 which the piston 11 was energized with the spring 14, descended, and was combined with the bottom rod 12 is stuck by pressure and carried out to a valve seat 5.

[0004] By the way, although the thing made from PTFE was used for diaphragm 6 in consideration of chemical resistance, propagation and an impact had the large thrust of the valve-closing time piston 11 to valve element 6a as it is, and particle generates and was easy [the above-mentioned conventional diaphragm valve]. Moreover, since fluid pressure stops applying to annular thin film section 6b at the moment of closing valve element 6a, the axial thrust of valve element 6a becomes high, and a fluctuating load becomes large, the force joins a valve seat 5 rapidly, and particle comes to arise. Furthermore, if the valve-opening close is performed several 10 times, it becomes that the bending test of the root section of the inner circumference of annular thin film section 6b carried out by vertical movement of valve element 6a, and bending stress concentrates on this part, especially, the root section of the inner circumference of annular thin film section 6b will come to be pulled, it will be easy to milk from an initial state, and particle will come to occur from here in the top dead center of valve element 6a.

[0005] on the other hand -- recently -- progress of high integration of a semi-conductor -- following -- increasingly -- particle -- the diaphragm valve made of resin which wet stations, such as a free washing station for LSI manufacture and an etching system, are required, and is used for this -- particle -- a free thing comes to be required and it cannot respond in the diaphragm valve made of resin which particle generates as mentioned above at every valve-opening close actuation.

[0006]

[Problem(s) to be Solved by the Invention] Then, this invention tends to offer the diaphragm valve made of resin which enabled it to control that particle occurs at every valve-opening close actuation.

[0007]

[Means for Solving the Problem] The diaphragm valve of this invention for solving the above-mentioned technical problem In the diaphragm valve made of the resin of the normal close type which presses with the piston energized with the spring in which the diaphragm made from PTFE was inserted by the valve seat side of a valve box at the cylinder top room, and intercepts flowing fluid for the interior of a valve box A damper spring is inserted in the bottom room of said cylinder. Said diaphragm A central valve element, It consists of the annular thin film section formed in the perimeter of the valve element at one, and a tubed attaching part formed in the perimeter of the annular thin film section at one. It is characterized by curving said annular thin film section in the shape of a cross-section facing-up ball, and connecting the root section of inner circumference almost at right angles to the top face of said valve element, and connecting the root section of a periphery almost at right angles to the inner skin upper limb of said tubed attaching part.

[0008] It is desirable to make it become $A > B > C$, setting to A the diameter of the root section of the periphery of the annular thin film section curved in the shape of [of diaphragm] a cross-section facing-up ball in this diaphragm valve, setting the diameter of the root section of inner circumference to C, and using the diameter of a valve element as B, and it is desirable to set up so that the ratio of A and B may become small as much as possible.

[0009] Since the damper spring is inserted in the bottom room of the cylinder of a valve mechanical component, the acceleration of a valve-closing time and a piston is made to decrease to the diaphragm valve constituted as mentioned above with a damper spring, thrust is made to be able to decrease it, and it can reduce the impact over the valve seat of a valve element, without spoiling a response, therefore can stick a valve element to software by pressure at a valve seat, and can control generating of particle. Moreover, only the part by which the annular thin film section was spherically curved at the time of valve-opening close actuation since the annular thin film section of diaphragm was curved by the shape of a cross-section facing-up ball, it connected almost at right angles [the root section of inner circumference] to the top face of a valve element and it connected almost at right angles [the root section of a periphery] to the inner skin upper limb of a tubed attaching part deforms elastically, and the root section of an inside-and-outside periphery has maintained the perpendicular condition mostly. Therefore, bending stress is not produced, but the root section is not milked at all and generating of particle is prevented.

[0010] Furthermore, the diameter A of the root section of the periphery of the annular thin film section curved in the shape of [of diaphragm] a cross-section facing-up ball, the diameter C of the root section of inner circumference, and the diameter B of a valve element are set up so that it may become $A > B > C$, if it is in some which made the ratio of A and B small as much as possible, the fluctuating load of a valve-closing time becomes small, the thrust of a valve element to a valve seat becomes small, and generating of particle is controlled. And the repulsive force at the time of making the annular thin film section curved in the shape of a cross-section facing-up ball transform at the time of valve-opening is set off against the force of pulling up a valve element, and the axial thrust of a valve element is reduced.

[0011]

[Embodiment of the Invention] Drawing 1 explains one example of the diaphragm valve of this invention. The same sign is given to the same components as drawing 3 among drawing 1 . Moreover, for a left half part, a valve-closing condition and the right half part of drawing 1 are in a valve-opening condition. The points that the diaphragm valve of this invention differs from the conventional diaphragm valve are having inserted the damper spring 20 in bottom room of cylinder 9 9b, and having replaced with diaphragm 21 the conventional diaphragm 6 directly engaged in closing motion of a valve.

[0012] The diaphragm 21 in the diaphragm valve of this invention The annular thin film section 23 formed in the perimeter of a central valve element 22 and a central valve element 22 by the product made from PTFE at one, It consists of a tubed attaching part 24 formed in the perimeter of the annular thin film section 23 at one. It is curved in the shape of a cross-section facing-up ball, and the root section 26 of a periphery is connected almost at right angles to the inner skin upper limb of said tubed attaching part 24 by connecting the root section 25 of inner circumference almost at right angles to the top face of said valve element 22, and said annular thin film section 23 is, as shown in drawing 2 .

[0013] And especially in this example, as shown in drawing 2 , the diameter of the root section 26 of the periphery of the annular thin film section 23 is set to A, the diameter of the root section 25 of inner circumference is set to C, and while making as [become / $A > B > C$] as a diameter B of a valve element 22, it

has set up so that it may become small, the ratio, i.e., A/B , of A and B.

[0014] Thus, it is a normal close type, and as usually shown in the left half part of drawing 1, a piston 11 is caudad energized with the spring 14 inserted in cylinder 9 top room 9a, the valve element 22 of the center of the diaphragm 21 combined with the bottom rod 12 is stuck to a valve seat 5 by pressure, and clausilium of the diaphragm valve of the constituted example is carried out. If Ayr is supplied to bottom room of cylinder 9 9b, as shown in the right half part of drawing 1, a spring 14 is resisted, a piston 11 goes up, and from a valve seat 5, the valve element 22 of the center of the diaphragm 21 combined with the bottom rod 12 will be isolated, and will be opened.

[0015] Since the damper spring 20 is inserted in bottom room of cylinder 9 of valve mechanical component 9b, the acceleration of the piston 11 by the valve-closing time and the spring 14 is made to decrease to the diaphragm valve of the example which performs the switching action of such a valve with the damper spring 20, thrust is made to be able to decrease it, and it can reduce the impact over the valve seat 5 of a valve element 22, without spoiling a response, therefore can stick a valve element 22 to software by pressure at a valve seat 5, and can control generating of particle.

[0016] Moreover, since the annular thin film section 23 of diaphragm 21 is curved in the shape of a cross-section facing-up ball, the root section 25 of inner circumference is connected almost at right angles to the top face of a valve element 22 and the root section 26 of a periphery is connected almost at right angles to the inner skin upper limb of the tubed attaching part 24. At the time of valve-opening close actuation, the annular thin film section 23 deforms elastically only the part curved spherically, and the root sections 25 and 26 of an inside-and-outside periphery have maintained the perpendicular condition mostly, as shown in drawing 1. Therefore, bending stress is not produced, but the root sections 25 and 26 are not milked at all, and generating of particle is prevented.

[0017] Furthermore, the diameter A of the root section 26 of the periphery of the annular thin film section 23 curved like the above-mentioned example in the shape of [of diaphragm 21] a cross-section facing-up ball. If it is in some which set up the diameter C of the root section 25 of inner circumference, and the diameter B of a valve element 22 so that it might become $A > B > C$ as shown in drawing 2, and set up the ratio of A and B small. The fluctuating load of a valve-closing time becomes small, the thrust of a valve element 22 to a valve seat 5 becomes small, and generating of particle is controlled. And force P1 in which repulsive force P1' at the time of making the annular thin film section 23 curved in the shape of cross-section facing-up radii transform at the time of valve-opening pulls up a valve element 22. Each other is offset and the axial thrust of a valve element 22 is reduced.

[0018]

[Effect of the Invention] The acceleration of the piston by the valve-closing time and the spring is made to decrease to the diaphragm valve of this invention with a damper spring, thrust is made to be able to decrease it, and it can reduce the impact over the valve seat of a valve element, without spoiling a response, therefore can stick a valve element to software by pressure at a valve seat, and can control generating of particle so that it may understand by the above explanation. Moreover, since the annular thin film section deforms elastically only the part curved spherically at the time of valve-opening close actuation and the root section of an inside-and-outside periphery has maintained the perpendicular condition mostly, bending stress is not produced, but the root section is not milked at all and generating of particle is prevented. Furthermore, the thing which the diameter A of the root section of the periphery of the annular thin film section, the diameter C of the root section of inner circumference, and the diameter B of a valve element are made to serve as $A > B > C$, and made A/B small. The fluctuating load of a valve-closing time becomes small, the thrust of a valve element to a valve seat becomes small, generating of particle is controlled, moreover, the repulsive force at the time of making the annular thin film section transform at the time of valve-opening is set off against the force of pulling up a valve element, and the axial thrust of a valve element is reduced.

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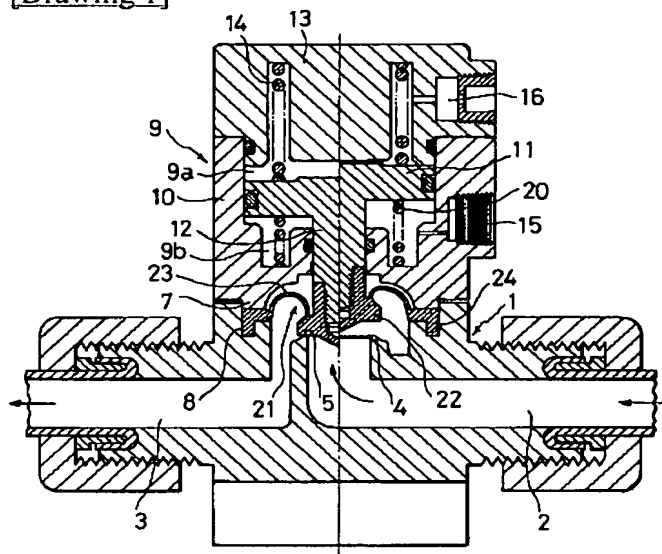
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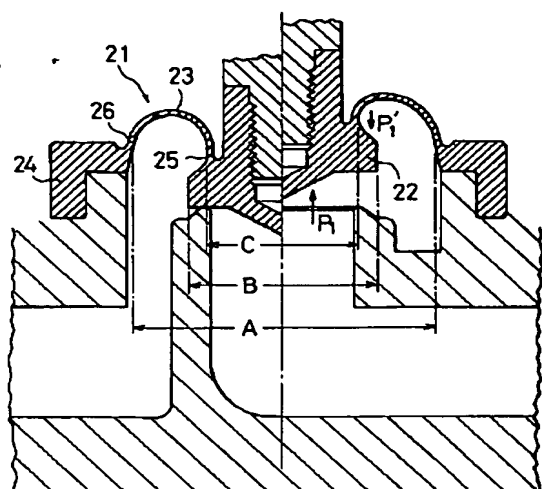
DRAWINGS

[Drawing 1]



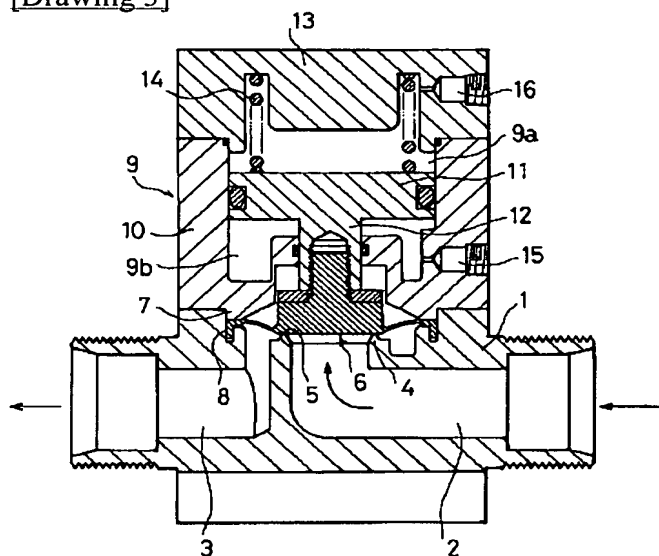
- 1... 弁箱
- 2... 流体流入通路
- 3... 流体流出通路
- 5... 弁座
- 9... シリンダ
- 9a... シリンダ上壁
- 9b... シリンダ下壁
- 11... ピストン
- 14... スプリング
- 20... ダンバースプリング
- 21... ダイアフラム
- 22... 中央の弁体
- 23... 環状薄膜部
- 24... 筒状保持部

[Drawing 2]

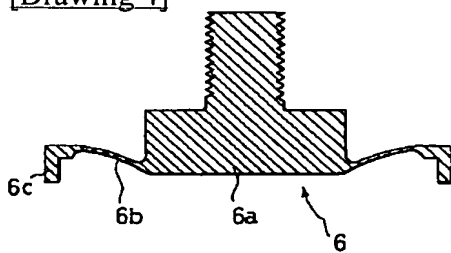


- 21...ダイヤフラム
 22...中央の弁体
 23...環状薄膜部
 24...筒状保持部
 25...環状薄膜部の内側の付根部
 26...環状薄膜部の外側の付根部
 A...環状薄膜部の外側の付根部の直径
 B...中央の弁体の直径
 C...環状薄膜部の内側の付根部の直径

[Drawing 3]



[Drawing 4]



[Translation done.]